

91267



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2

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Level 2 Mathematics and Statistics 2020

91267 Apply probability methods in solving problems

9.30 a.m. Thursday 19 November 2020
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Apply probability methods in solving problems.	Apply probability methods, using relational thinking, in solving problems.	Apply probability methods, using extended abstract thinking, in solving problems.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

Make sure that you have Formulae Sheet L2–MATHF.

Show ALL working.

If you need more room for any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–12 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

TOTAL

ASSESSOR'S USE ONLY

Owning an electric vehicle (EV) in New Zealand has become more popular as the technology has improved, prices have dropped, and people have become more aware of environmental issues.

The questions in this paper relate to research about EVs.



<https://www.my-car-w.com/about>

QUESTION ONE

Tia finds the results of a survey conducted on staff and students of a New Zealand university. The survey asked about various matters related to ownership of EVs.

- 15% of the survey respondents were staff and the rest were students.
- 90% of the staff and 43% of the students drove to the university.
- Of the students who drove to the university, 36% said they would like to own an EV, while 60% of the students who did not drive to the university said they would like to own an EV.

- (a) (i) Find the probability that a randomly chosen respondent in the survey is a staff member who drove to the university.

- (ii) Find the probability that a randomly chosen respondent in the survey is a student who did not drive to the university and would **not** like to own an EV.

- (iii) If a **student** respondent said they would like to own an EV, what is the probability that they drove to the university?

- (iv) Of the staff who drove to the university, 52% said they would like to own an EV, while only a quarter of the staff who didn't drive to the university would like to own an EV.

What percentage of **all** survey respondents would like to own an EV?

QUESTION TWO

“Range anxiety” is the worry that electric vehicle (EV) drivers have about how long their battery charge will last. This is one of the most common concerns that stops people from buying an EV.

- (a) A car manufacturer claimed that its EV was able to travel 172 km on one full battery charge. Geoff, an EV owner, recorded the distance that his car travelled after each full battery charge, and found it could be modelled by a normal distribution, with a mean of 165 km and a standard deviation of 14 km.
- (i) Find the probability that Geoff’s EV will travel between 150 km and 165 km on one full battery charge.

- (ii) Find the probability that Geoff’s EV will travel more than 172 km on one full battery charge.

- (iii) 10% of the time Geoff is unsatisfied with how far one full battery charge takes his EV.

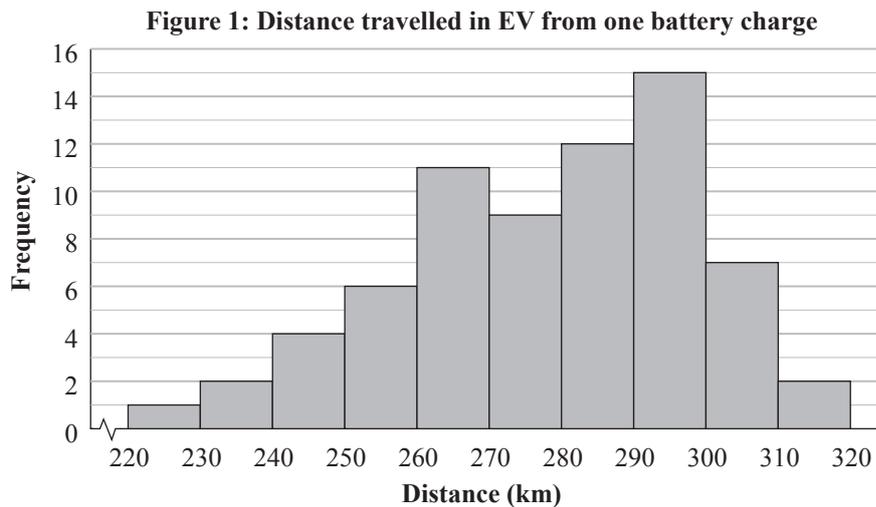
For Geoff to be satisfied, what is the minimum distance his car will have to travel on one full battery charge?

- (b) The same car manufacturer released a second-generation EV.

A new owner of a second-generation EV found that 20% of the distances travelled on a full battery charge were less than 265 km.

Calculate an estimate for the mean distance travelled on a full charge by a second-generation EV for this owner. Assume that the distances travelled can be modelled by a normal distribution with a standard deviation of 14 km.

- (c) An independent company completed 70 test drives of a second-generation EV. Each test started with a full battery charge and ended when an indicator showed that the expected remaining travel distance was less than 5 km. Each test involved driving on a range of city roads at different times of the day on weekdays. The results are shown in Figure 1 below.



QUESTION THREE

Studies have found some links between EV ownership and the installation of a home solar system.

An online survey was taken in North America of EV owners, plug-in hybrid vehicle (PHEV) owners and other interested people (who owned non-electric vehicles) during a three-month period in 2018.

The results are summarised in the table below.

Table 1: Vehicle type and home solar system ownership in North America

	Home solar system	No home solar system	Total
Electric vehicle (EV)	104	171	275
Plug-in hybrid electric vehicle (PHEV)	45	100	145
Non-electric vehicle	205	1375	1580
Total	354	1646	2000

(a) Use Table 1 to answer parts (i) to (iv).

(i) What proportion of survey respondents owned an EV or a PHEV?

(ii) Which type of vehicle owner (EV, PHEV or non-electric) in North America is more likely to have a home solar system, according to these survey results?

- (iii) There were 22 144 home solar systems installed in New Zealand by the end of 2018.

Use the results from the North American study in Table 1 to estimate how many of the home solar system owners in New Zealand also have EVs.

- (iv) Give at least one statistical reason why using Table 1 in your answer to part (iii) may not lead to a valid estimate in this case.

Please turn over ►

- (b) A similar survey was conducted in Europe at the same time. Some of these results are shown in Table 2 below.

Table 2: Vehicle type and home solar system ownership in Europe

	Home solar system	No home solar system	Total
Electric vehicle (EV)		162	225
Plug-in hybrid electric vehicle (PHEV)	23		96
Non-electric vehicle			
Total	271		1200

- (i) Complete the table above and use it to find the probability that a randomly selected respondent whose vehicle was non-electric, had a home solar system.

- (ii) A newspaper article quoted some of the findings from the two studies shown in Table 1 and Table 2. It claimed that:
- In North America, EV owners are **3 times** as likely to have a home solar system as non-electric vehicle owners
 - In Europe, EV owners are **only 30%** more likely to have a home solar system than non-electric vehicle owners.

(Table 1 from page 8 is repeated below)

Table 1: Vehicle type and home solar system ownership in North America

	Home solar system	No home solar system	Total
Electric vehicle (EV)	104	171	275
Plug-in hybrid electric vehicle (PHEV)	45	100	145
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